

# Appendix G

## Role of Existing Hatcheries

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This appendix describes how existing hatcheries may play a role in the recovery of California's coho salmon. Appendix H provides guidelines for the operation of hatcheries.

## BACKGROUND

The Hatchery Working Group of the CRT met on June 12, 2003, to discuss the role of existing coho salmon artificial production facilities in coho salmon recovery. The following report contains elements agreed upon at that meeting and subsequent additions by Working Group members. Not all Working Group members supported the addition of the following subsections entitled "Principles of hatchery operation in support of coho salmon recovery," "Monitoring and Evaluation Recommendations," and "Specific Recommendations" in this section of the Recovery Strategy. However, these subsections are included in this draft to reflect the contributions of all Working Group members and decisions made at the meeting.

Table G-1 lists the coho salmon artificial production facilities that are currently active in California.

**TABLE G-1:** Recent coho salmon production facilities in California

FACILITY NAME	OPERATOR	TYPE OF FACILITY	STREAM	LOCATION (COUNTY)	ESU <sup>1</sup>	OPS. BEGAN
Big Creek Hatchery	Private/NOAA Fisheries	Cooperative Enhancement Recovery	Big Creek (Tributary to Scott Creek)	Santa Cruz	CCC	1986
Don Clausen/Warm Springs Hatchery	CDFG	Mitigation/Enhancement/Recovery	Dry Creek (Tributary to Russian River)	Sonoma	CCC	1980
Noyo Egg Taking Station	CDFG	Enhancement	South Fork Noyo River	Mendocino	CCC	1962
Mad River Hatchery	CDFG	Enhancement	Mad River	Humboldt	SONCC	1970
Trinity River Hatchery	CDFG	Mitigation	Trinity River	Trinity	SONCC	1958
Iron Gate Hatchery	CDFG	Mitigation	Klamath River	Siskiyou	SONCC	1965
Rowdy Creek Hatchery	Private	Cooperative Enhancement	Rowdy Creek (Tributary to Smith River)	Del Norte	SONCC	1972

### NOTES:

1. ESU abbreviations are CCC: Central California Coast Coho ESU, SONCC: Southern Oregon/Northern California Coasts Coho ESU.

**SOURCE:** CDFG 2002 with modification

## NOAA FISHERIES PRELIMINARY EVALUATION OF THE POTENTIAL ROLE OF COHO SALMON HATCHERIES IN COHO SALMON RECOVERY

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NOAA Fisheries (2003) assigned each current California coho salmon hatchery program to a category from 1 to 4, based on variation in 1) the degree of genetic divergence between the hatchery stock and the natural populations that occupy the watershed into which the hatchery stock is released, 2) the origin of the hatchery stock, and 3) the status of the natural populations in the watershed. This categorization is intended to provide useful information for determining the ESU status of individual hatchery stocks, and may also be useful as a rough guide for determining the potential usefulness of a stock for conservation purposes. However, the decision to use or avoid using a particular stock for purposes of conservation requires a detailed evaluation of each particular case, including evaluation on the relative benefits and risks of artificial propagation and other conservation strategies (NOAA Fisheries 2003).

This information emphasizes a conservative approach towards the use of hatcheries in the role of recovery, and takes into consideration the fact that it is not known if or how current hatchery programs will fit into the coho salmon recovery process. NOAA Fisheries is currently undergoing review of its hatchery policy based on the most accurate scientific information pertinent to the consideration of artificial propagation in ESA listing decisions. The new Federal hatchery listing policy is intended to more clearly articulate how NOAA Fisheries will consider hatchery salmonids in evaluating the risk of extinction for Pacific salmon and steelhead Evolutionarily Significant Units (ESUs), and in making subsequent listing determinations under the ESA. Completion of this process and finalization of the NOAA Fisheries Hatchery Policy is not expected before the end of 2003. Concurrently, NOAA Fisheries initiated status reviews of 25 West Coast salmonid ESUs. Updated ESA listing determinations will be proposed after preliminary analysis and review of the best available scientific information, and after consideration of protective measures being carried out to protect the species. Finalization of updated Federal ESU listing determinations is expected in 2004.

In consideration of possible dichotomies between the final NOAA Fisheries policies and those of the CRT, the Department, in consultation with NOAA Fisheries, will evaluate how to incorporate these documents into the Coho Salmon Recovery Strategy when they become available.

The following is excerpted from NOAA Fisheries (2003). Hatchery categories are highlighted in bold and italics in the text. The profile of the each coho salmon hatchery in the following accounts is meant to provide background that led to its subsequent category rating. All citations and personal communications in this section are as cited in NOAA Fisheries (2003); the original citations were not necessarily reviewed by members of the Working Group. *Blank spaces in the following excerpt from NOAA Fisheries (2003) were left blank as in the original draft document.*

The categories in each account are defined as follows:

- Category 1 stocks are characterized by no more than minimal divergence between the hatchery stock and the local natural populations and regular, substantial incorporation of natural origin fish into the hatchery broodstock. Within category 1, category 1a stocks are characterized by the existence of a native natural population of the same species in the watershed, while category 1b stocks are characterized by the lack of such a population (e.g., the local naturally spawning population was introduced from elsewhere). Note that a category 1a designation can describe a range of biological scenarios, and does not necessarily imply that the hatchery stock and the associated natural population are close to a 'pristine' state.

- Category 2 stocks are no more than moderately diverged from the local, natural population(s) in the watershed. Category 2a stocks were founded from a local, native population in the watershed in which they are released. Category 2b stocks were founded non-locally but from within the ESU, and are released in a watershed that does not contain a native natural population. Category 2c stocks were founded non-locally but from within the ESU, and are released in a watershed that contains a native natural population.
- Category 3 stocks are substantially diverged from the natural populations in the watershed in which they are released. The >a=, >b=, and >c= designations are the same as described for category 2.
- Category 4 stocks are characterized either by being founded predominantly from sources that are not considered part of the ESU in question, or by extreme divergence from the natural populations in the watershed in which they are released, regardless of founding source.

#### 1. STOCK NAME: IRON GATE HATCHERY COHO SALMON (KLAMATH COHO SALMON [CDFG])

*Hatchery/Collection Site:* Iron Gate Hatchery is on the Klamath River 306 km upriver near Hornbrook (CDFG/NMFS 2001). This hatchery was built by Pacific Power and Light Company to mitigate the Iron Gate Project and is operated by the Department. Fish are collected at an auxiliary ladder at the hatchery outlet and at the main ladder at the base of Iron Gate Dam.

##### Broodstock Origin and History

*Year Founded:* The hatchery was founded in 1965, with the first releases occurring in 1966.

*Source:* The Iron Gate Hatchery coho salmon stock was founded with Trinity River fish released in 1966 and Cascade (Columbia River) fish released in 1966, 1968, 1969, and 1970. Other stocks released from Iron Gate include Trinity (1969 and 1977) and unknown (1970). Only Klamath stocks have been released at the hatchery since 1977. The Klamath Basin has also been planted with other hatchery stocks including Darrah Springs and Mad River hatcheries (NMFS 1997).

*Broodstock Size/Natural Population Size:* An average of 1,120 adult coho salmon were trapped and 161 females were spawned during the brood years 1991 to 2000 (Hiser 1993-95, Rushton 1996-2002a). Coho salmon runs in the Klamath River Basin have been greatly diminished and are now largely composed of hatchery fish (CDFG 1994).

##### Subsequent Events

*Recent Events:* All coho salmon have been marked with a left maxillary clip since 1995. Hatchery and naturally spawned fish are used in the broodstock in proportion to that which return to the hatchery (CDFG/NMFS 2001).

*Relationship to Current Natural Population:* Data not available.

*Current Program Goals:* The hatchery coho salmon production goals are 75,000 yearlings raised to 1020/lb and released from March 15 to May 1 (CDFG/NMFS 2001).

*Population Genetics:* Allozyme data indicate that there is little genetic structure in California and Oregon coho salmon, but a Northern and a Southern group are apparent (Weitkamp et al. 1995). Iron Gate Hatchery samples fall within the Northern group, but are not uniquely grouped. New microsatellite DNA data for California coho salmon show Iron Gate and Trinity

hatcheries grouped closely together as the only Northern samples and distant from other more Southern coho salmon samples (D. Hedgecock pers. comm.).

*Morphology/Behavior/Fitness:* No data available.

*Previous Determination:* NMFS (1997) was uncertain about the Iron Gate stock ESU status.

*Category and Rationale:* Category 2c. Since the late 1970s, the entire broodstock has originated from the Klamath River Basin, and has included some natural origin fish. The current relationship between the hatchery and natural populations in the basin is uncertain, however. The hatchery population may be somewhat diverged from the local natural populations. The pre-1977 introductions of non-local stocks may have also influenced the hatchery stock.

## 2. STOCK NAME: TRINITY RIVER HATCHERY COHO SALMON (TRINITY RIVER COHO SALMON [CDFG]).

*Hatchery/Collection Site:* Trinity River Hatchery is located below Lewiston Dam 248 km upriver (CDFG/NMFS 2001). The trap is located at the hatchery.

### Broodstock Origin and History

*Year Founded:* The hatchery was completed in 1963 and the first release of coho salmon was in 1966. Trapping began in 1958.

*Source:* The Trinity River Hatchery coho salmon broodstock was started using progeny of fish collected at the weir, but Eel River (1965), Cascade (1966-1967, 1969), Alsea (1970), and Noyo (1970) stocks were released as well. Trinity River fish were also released in those years. Only Trinity River stocks have been released from the hatchery since 1970. Trinity River coho salmon has been a very productive program and is often used as a source of coho salmon in other hatcheries throughout California. The same non-local stocks used at the hatchery were also released elsewhere in the Trinity Basin.

*Broodstock Size/Natural Population Size:* About 3,814 adult coho salmon were trapped during 1991 to 2001, and about 562 females were spawned during brood years 1991 to 2001 (Ramsden 1993-2002). It is commonly assumed that there is little to no natural coho salmon production in the Trinity Basin except for Trinity River Hatchery strays (CDFG/NMFS 2001).

### Subsequent Events

*Recent Events:* All coho salmon are marked starting with the 1995 brood year with a right maxillary clip. Hatchery and naturally spawned fish are used in the broodstock in proportion to that which return to the hatchery (CDFG/NMFS 2001).

*Relationship to Current Natural Population:* It is commonly assumed that there is little to no natural coho salmon production in the Trinity Basin except for Trinity River Hatchery strays (CDFG/NMFS 2001).<sup>1</sup>

*Current Program Goals:* The hatchery coho salmon production goals are 500,000 yearlings raised to 10-20/lb and released from March 15 to May 1 (CDFG/NMFS 2001).

*Population Genetics:* Allozyme data, as mentioned above, indicate little genetic structure for coho salmon in California (Weitkamp et al. 1995). All the Trinity samples are in the Northern group with the two Trinity River Hatchery samples grouped together within the Northern

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<sup>1</sup> The hatchery category for this hatchery was influenced by the assumption that there is no natural production in the Trinity River. However, more recent information suggests that perhaps about 10% of the total production in the Trinity River is natural production (S. Witalis pers. comm.; W. Sinnen pers. comm. as cited in CDFG 2002). Reevaluation in light of this new information might result in modification of the NOAA Fisheries hatchery category for Trinity River Hatchery.

group. However, Trinity samples are separate from Deadwood Creek, Trinity River, and Iron Gate Hatchery. The microsatellite data show Iron Gate and Trinity Hatcheries grouped closely together and away from more Southern coho salmon (D. Hedgecock pers. comm.).

*Morphology/Behavior/Fitness:* No data available.

*Previous Determination:* NMFS (1997) determined that the Trinity River Hatchery stock was in the ESU, but not essential for recovery. However, it was determined that this hatchery may play an important role in recovery efforts because there appears to be no natural production in the basin.

*Category and Rationale:* Category 2b. Although this stock has had introductions from non-local sources, since 1970, all of the broodstock has come from the hatchery weir. Genetic evidence does not group Trinity fish with the recorded source populations, suggesting that these introductions may have had little influence on the current stock. The relationship between the hatchery stock and any remaining natural populations in the basin is uncertain, but because of extensive hatchery straying, there is little reason to believe that there is substantial divergence between the natural and hatchery populations.

### 3. STOCK NAME: MAD RIVER HATCHERY COHO SALMON (MAD RIVER COHO SALMON [CDFG]).

*Hatchery/Collection Site:* Mad River Hatchery is located 20 km upriver near the town of Blue Lake, California (CDFG/NMFS 2001). The trap is located at the hatchery. Since 1995, the trap has been inoperable and all fish entering the hatchery through the ladder have been volunteers.

#### Broodstock Origin and History

*Year Founded:* The hatchery opened in 1970 and the first coho salmon were released in 1971.

*Source:* Mad River Hatchery has used the greatest number of coho salmon broodstocks, both out-of-basin and out-of-ESU, of any Department hatchery. The stock was begun with Noyo broodstock, released in 1970. Fish from the Noyo stock were released from the hatchery for an additional 11 years (1971, 1972, 1975, 1976, 1981, 1985, 1988, 1991, 1993-1994, and 1996). Other stocks released from the hatchery include Alsea (1973), Klamath (1981, 1983, 1986-1989), Klaskanine (1973), Prairie Creek (1988, 1990), Sandy (1980), Green River (1979), Trask (1972), Trinity (1971), and unknown (1977). Darrah Springs used exotic stocks to also release numerous coho salmon into the Mad River during 1960s and 1970s (NMFS 1997).

*Broodstock Size/Natural Population Size:* About 38 adult coho salmon were trapped from 1991 to 2000, with 16 females spawned during the brood years 1991 to 1999 (Gallagher 1994 a, b, c, 1995; Cartwright 1996-2001).

#### Subsequent Events

*Recent Events:* Since the 1998 brood year, trapping operations have averaged 23 fish. The program is undergoing re-evaluation. The 1999 coho salmon brood year was the last raised and was released in March of 2001.

*Relationship to Current Natural Population:* There are no coho salmon abundance estimates for the Mad River, but juveniles are widely distributed throughout the basin (NMFS 2001).

*Current Program Goals:* The hatchery is California's only supplementation hatchery. Its coho salmon production goal before ending the program was 250,000 yearlings raised to 8-10/lb and released from March to May (CDFG/NMFS 2001).

*Population Genetics:* Hjort and Schreck (1982) evaluated a number of coho salmon hatchery stocks based on one locus. The Mad River Hatchery clusters separately from Iron Gate and Trinity hatcheries.

*Morphology/Behavior/Fitness:* No data available.

*Previous Determination:* NMFS (1997) determined that the Mad River Hatchery stock was not in the ESU.

*Category and Rationale:* Category 4. The program has a large, and recent, use of out-of-basin and out-of-ESU broodstock. The program has been ended and this decision only considers coho salmon that returned during 2002.

#### 4. STOCK NAME: NOYO RIVER FISH STATION COHO SALMON (NOYO COHO SALMON [CDFG])

*Hatchery/Collection Site:* The Noyo River Egg Station is located on the South Fork Noyo River within the Jackson State Demonstration Forest 17 km inland of Fort Bragg (Jones 2001). Fish are spawned at the station, but incubated and raised at a number of Department facilities, most commonly Mad River Hatchery, Don Clausen Fish Hatchery, and Silverado Fish Transfer Station. Coho salmon are imprinted at the Noyo Station for a minimum of two weeks before release.

##### Broodstock Origin and History

*Year Founded:* The site was originally constructed as a research facility in 1961, but egg-taking activities were initiated immediately.

*Source:* There are no records of broodstock from other locations being used at Noyo. The Noyo program has been very successful. Introductions into other watersheds using Noyo fish have been extensive. Marking has been sporadic, but when available, hatchery fish are excluded from the broodstock. Out-of-ESU coho salmon have been planted in the Noyo River, including Alsea (Oregon Coast ESU) and Klaskanine (Lower Columbia River ESU) fish.

*Broodstock Size/Natural Population Size:* There was an average of 524 fish trapped from 1991 to 2001 and 100 females spawned in brood years 1991 to 2001 (Grass 1992-2002). However, in 1998 and 1999, only 16 and 85 fish were trapped. There are no coho salmon abundance estimates for the Noyo River, but juveniles are widely distributed and abundant throughout the basin (NMFS 2001).

##### Subsequent Events

*Recent Events:*

*Relationship to Current Natural Population:*

*Current Program Goals:* The program's goal is to develop a minimum sustained escapement to the South Fork Noyo River of 1,500 adult coho salmon annually. To reach this goal, the program target is 75,000 smolts released from March to April each year (Hunter 1987).

*Population Genetics:* Microsatellite data show Noyo samples clustering tightly with other coho salmon stocks south of the Eel River (D. Hedgecock pers. comm.).

*Morphology/Behavior/Fitness:*

*Previous Determination:* NMFS (1997) determined that the Noyo River Hatchery stock was in the ESU, but a final decision was deferred.



*Category and Rationale:* Category 2a. The stock founded several decades ago from local collections, and there have been no out-of-basin stocks introduced into the broodstock over its history. An unknown but probably no more than moderate proportion of naturally spawned fish have been included into broodstock ever year.

5. STOCK NAME: DON CLAUSEN HATCHERY COHO SALMON  
(WARM SPRINGS COHO SALMON [CDFG]).

*Hatchery/Collection Site:* The Don Clausen Fish Hatchery is located on Dry Creek at the base of Warm Springs Dam, 71 km upstream from the mouth of the Russian River. The trap is at the hatchery.

Broodstock Origin and History

*Year Founded:* The hatchery went into service in 1980. The first releases were in 1981.

*Source:* Noyo River coho salmon were heavily planted into the Russian River. The program was considered unsuccessful and ended in 1996. Starting in 2001, a captive broodstock program was initiated. Fish for the captive broodstock program are obtained by electrofishing 300 to 600 juveniles from the Green Valley and Mark West Springs Creeks (Russian River Basin), or the Olema and Redwood Creeks (Marin County) if necessary (NMFS 2002a).

*Broodstock Size/Natural Population Size:* From 300 to 600 juveniles will be taken from the Russian River, or failing that, the Lagunitas-Olema system. No population estimates are available for the Russian River Basin, but fish are rare and only occur consistently in Green Valley Creek (NMFS 2002a).

Subsequent Events

*Recent events:* In 2001, 337 juvenile coho salmon were taken from Green Valley and Mark West Springs Creeks (Russian River Basin), and Olema Creek to initiate the captive broodstock program (NMFS 2002a).

*Relationship to Current Natural Population:*

*Current Program Goals:* The captive broodstock program proposes to release 50,000 fingerlings and 50,000 yearlings into five Russian River streams.

*Population Genetics:* Allozyme data show Willow Creek, Russian River, grouping with the Southern cluster, closest to the South Fork of the Eel River (Weitkamp *et al.* 1995). Newer microsatellite data show the previous hatchery closely related to the Noyo River and Lagunitas Creek samples (D. Hedgecock pers. comm.)

*Morphology/Behavior/Fitness.*

*Previous Determination:* There has been no previous NMFS consideration of the new Don Clausen captive broodstock hatchery program.

*Category and Rationale:* Category 1a. This stock is recently founded from a native natural population.

6. STOCK NAME: KINGFISHER FLAT (BIG CREEK) HATCHERY COHO SALMON  
(SCOTT CREEK COHO SALMON [MBSTP]).

*Hatchery/Collection Site:* Kingfisher Flat Hatchery is located on Big Creek, a tributary of Scott Creek, 6 RM from the mouth. This hatchery takes on increased importance because it is the

Southern extent of coho salmon's range. Broodstock are taken by divers netting adults usually in Big Creek below the hatchery. However, this can also occur throughout the Scott Creek system (NMFS, draft biological opinion).

#### Broodstock Origin and History

*Year Founded:* The Monterey Bay Salmon & Trout Program (MBSTP) started the Kingfisher Flat hatchery in 1975, but it was not in operation until 1982. California State hatchery activity near this site has a long history back to 1904 (Strieg 1991). Due to flood damage, the State hatchery program ended in 1942. There was also a nearby ocean-ranching operation, SilverKing Oceanic Farms, at Waddell Creek and the San Lorenzo River from the 1960s until the early 1980s.

*Source:* Since 1976, when the MBSTP took over operations, there have been no out-of-basin fish introduced into Scott Creek. Since then, broodstock have been taken by nets in Scott Creek. All coho salmon are marked. No hatchery fish are used in spawning unless minimum goals are not met. Mating occurs in a factorial protocol. Prior to 1942, when there was a State hatchery, there were widespread introductions of broodstock from within California, including Mt. Shasta (1913, 1915, 1917, 1928, and 1937), Ft. Seward (1930, and 1932), and Prairie Creek (1933, 1934, 1936, 1938, and 1941) hatcheries. This stock was considered an extremely healthy one and was widely planted throughout the State's coastal streams. During the Silver-King operation, broodstock was obtained from Oregon, Washington, British Columbia, and Alaska.

*Broodstock Size/Natural Population Size:* Up to 30 females and 45 males can be taken with the restriction that the first 10 spawning pairs to be observed must be undisturbed. Then, only one out of four females may be taken to insure natural spawning. However, in recent years, few to no fish have been taken for spawning due to low abundance. However, in 2001, 123 coho salmon were observed and 26 wild females were taken for spawning. Of the remaining 97 coho salmon, 43 were marked. There are no abundance surveys, but coho salmon are well distributed within the Scott Creek basin (NMFS, Draft BO).

#### Subsequent Events

*Recent Events:* Starting in 2002, a captive broodstock program for Scott Creek was initiated at the NMFS Santa Cruz Laboratory. The 2001 returning coho salmon numbers to Scott Creek were estimated to be well over 300. The hatchery staff handled 109 females (26 wild) and 123 males (36 wild).

#### *Relationship to Current Natural Population:*

*Current Program Goals:* The goal is to spawn 30 unmarked females and 45 unmarked males to obtain approximately 60,000 eggs (NMFS 2002b).

*Population Genetics:* Microsatellite data show Scott Creek samples, including Big Creek Hatchery samples, clustering tightly together as a branch of the Central California group (D. Hedgecock pers. comm.).

#### *Morphology/Behavior/Fitness:*

*Previous Determination:* NMFS (1996) determined that the Kingfisher Flat Hatchery stock was in the ESU, but a final decision was deferred.

*Category and Rationale:* Category 1a. There have been no introductions into the watershed in the last 30 years and, in most years, the broodstock has consisted substantially or entirely of wild fish.

## PRINCIPLES OF HATCHERY OPERATION IN SUPPORT OF COHO SALMON RECOVERY

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To minimize the loss of both overall and adaptive genetic diversity in existing coho salmon populations with hatchery influence, incorporation of conservation strategies in hatchery operations should include comprehensive genetic analyses to detect inbreeding, outbreeding, and domestication selection, and rearing and release techniques that maximize fitness and reduce straying. All aspects of hatchery operations that affect the health and survival of both hatchery and natural fish should be rigorously monitored and evaluated to maximize the probability of long-term success.

Coho salmon production facilities should operate according to the following principles in support of recovery of coho salmon:

1. Justification for coho salmon hatchery production should be based on the best scientific information and be consistent with recovery goals.
2. Hatcheries should not impede recovery of coho salmon.
3. Hatcheries should:
  - a. conserve the full range of existing genetic diversity of the run;
  - b. not affect morphological, physiological, ecological, reproductive, or behavioral features of coho salmon that reduce fitness; and
  - c. not negatively affect any endemic natural populations in the streams where hatchery fish are released.
4. Hatchery operations and monitoring should be managed in support of recovery using the best scientific information.
5. Hatcheries should as much as possible be managed to meet mitigation requirements, while avoiding further degradation of natural coho salmon production and impediments to recovery.
6. Department and Commission policies should focus on natural stocks as the basis of California's salmon production.
7. All artificially produced coho salmon should continue to receive an external mark along with any other marks or tags deemed necessary to effectively monitor and evaluate the effect of the hatchery program on recovery. Marking facilitates broodstock management and identification of all hatchery-origin coho salmon for monitoring.
8. Hatchery monitoring and evaluation plans should be designed to measure the effect of hatchery production on coho salmon recovery.
9. Hatchery management and operations should address Tribal Trust, Department/NOAA Fisheries Hatchery Recommendations, and Hatchery and Genetic Management Plans while maximizing attainment of recovery goals for coho salmon.
10. Coho salmon hatcheries should be managed to maintain Tribal fisheries to the maximum extent possible, while still attaining recovery goals.
11. Prior to the establishment of conservation programs, all hatcheries will be required to develop Hatchery and Genetic Management Plans.
12. Research is an appropriate secondary objective for a coho salmon hatchery, especially for research that addresses coho salmon recovery relative to hatchery operations.

13. Coho salmon hatcheries should operate in a way that maximizes the effective population size of the hatchery and hatchery + natural populations while at the same time preserving existing adaptive variation, within-population diversity, and between-population diversity.
14. Small rearing programs have traditionally produced coho salmon throughout their range in California. These programs should be consistent with the recovery guidelines presented here.

## **MONITORING AND EVALUATION RECOMMENDATIONS**

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Concurrent hatchery and recovery programs can only be successful with appropriate monitoring to estimate the contribution of artificially propagated fish to the natural population during the supplementation process, and to monitor genetic characteristics of the natural and hatchery populations. At the same time, habitat assessments and baseline monitoring and evaluation of the physical and biological components of the ecosystem are necessary to monitor quality and quantity in the receiving environment. These important tools provide a means to evaluate ways of improving hatchery activities and increase the chances of successful recovery efforts.

In order to effectively monitor the effects of current and future coho salmon artificial propagation on recovery of coho salmon, the Hatchery Working Group recommends that the Department work toward establishing or maintaining the following management, monitoring, and evaluation elements:

1. Obtain accurate adult censuses of natural- and hatchery-origin coho salmon whenever possible, including hatchery contribution to natural spawning, elucidate interactions among hatchery- and natural-origin fish, estimate natural- and hatchery-origin stray rates.
2. Continue and expand efforts to gather up-to-date baseline population genetics data on all natural- and hatchery-origin coho salmon stocks, especially those that have the potential to be affected (positively or negatively) by hatchery production.
3. Use historic and contemporary outmigrant and hatchery marking data to analyze production and outmigration timing of hatchery- and natural-origin stocks. Expand or modify monitoring as necessary to ensure that monitoring meets data needs for effective evaluation of hatchery/natural fish interactions.
4. Develop an overarching plan within the Department, NOAA Fisheries, and Tribal governments for achieving and modifying hatchery goals in the context of recovery of natural coho salmon runs while maintaining Tribal trust obligations to mitigate for lost habitat.
5. Develop a mechanism for proposing modifications to hatchery operations to aid recovery of coho salmon that is inclusive of all affected groups, that recognizes:
  - a. the unique responsibilities of the Department's hatchery and biology staff and managers to manage these facilities according to the Department and FGC policies in the public trust;
  - b. Federal Tribal trust obligations;
  - c. NOAA Fisheries responsibilities under the ESA;
  - d. existing agreements, regulations, mitigation obligations, and planning processes; and
  - e. CESA requirements and other requirements under law.

6. Modify hatchery operations to actively aid recovery whenever possible and to, at minimum, avoid impeding coho salmon recovery.
7. Actively pursue opportunities to collect data on morphology, physiology, behavior, and ecology of hatchery- and natural-origin coho salmon with the goal of identifying and minimizing any negative fish culture or fish release effects on native, naturally occurring populations of CESA- and ESA-listed salmonids, and their habitat.
8. Continue evaluations of Department hatchery management with the goal of managing hatcheries to maximize natural production and minimize negative effects.
9. Increase broodstock monitoring and management intensity (e.g., genetic management of broodstock, broodstock collection and spawning strategies, rearing and release strategies, evaluation of effective population size) as necessary to a level commensurate with protection of listed stocks.
10. Avoid ecological/behavioral impacts of coho salmon hatchery releases on other endemic species (e.g., Chinook salmon and steelhead).
11. Avoid ecological/behavioral impacts of Chinook salmon and steelhead hatchery releases on coho salmon.
12. Initiate assessment and monitoring of stream and ocean carrying capacity and the relation of hatchery production to density dependent effects, especially density dependent mortality.

## SPECIFIC RECOMMENDATIONS

The following specific recommendations were forwarded from the Hatchery Working Group and rely heavily on the Department/NOAA National Marine Fisheries Service Southwest Region Joint Hatchery Review Committee Final Report on Anadromous Salmonid Hatcheries in California (CDFG/NMFS 2001).

Since the hatchery review (CDFG/NMFS 2001) was prepared, more genetic information has become available with which to evaluate natural and hatchery coho salmon stocks in both the CCC Coho ESU and the SONCC Coho ESU (Hedgecock et al. 2003; J.C. Garza pers. comm.). This information and any new information on population genetics will be incorporated into recovery planning as it becomes available.

1. Evaluate the potential of the Noyo Fish Taking Station to develop a role as a research facility due to the putative purity of the stock there and the presence of a barrier at which to collect data and control entry to and exit from the system.
2. Incorporation of recovery strategies for coho salmon in hatchery operations should be consistent with other ongoing planning processes including NOAA Fisheries' ESA recovery planning process, annual reviews of Trinity River Hatchery operations in the context of the Federal Tribal Trust obligation of Trinity River Hatchery, and the re-licensing of the Klamath River Project, including the Iron Gate Dam and Hatchery.
3. The Department, Tribes and NOAA Fisheries should follow through with HGMP plans to consider how or whether the coho salmon program at Trinity River Hatchery should be utilized in the recovery of Trinity Basin coho salmon (CDFG/NMFS 2001). These plans should be based on the most recent popula-

tion genetics and demographic information on the composition of the existing coho salmon run to the basin and the influence of the abundant hatchery stock on the remnant natural stock.

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